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Faulting and the Physiography of the Croydon Sunkland, Victoria

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Abstract: New structural evidence for the development of the Croydon Sunkland of Central Victoria shows it to be largely if not entirely fault controlled.

INTRODUCTION

The area discussed (Fig. 1) is part of the Central Victoria Silurian-Devonian flysch belt. The present paper is the result of geological mapping of the Yan Yean 1:63360 sheet carried out for the Geological Survey of Victoria during 1968-69.

PHYSIOGRAPHY

The broad physiographic divisions were first determined by Jutson (1911). Subsequently later workers have shown that there are three main physiographic divisions (Fig. 1): the Nillumbik Terrain (Hills 1934), the Croydon Sunkland (Juston 1911) and the Triassic Erosion Surface (Neilson 1967).

The Triassic Erosion Surface is an old erosion surface which, according to Neilson (1967, 1970), was much more extensive during the Mesozoic. It is the oldest physiographic division of the area; it has an extensive development of red soils, often more than 5 m deep, which must represent prolonged pedogenesis. The Triassic Erosion Surface ranges in height from 360 m south of Kinglake to more than 800 m on the Divide, and decreases to 125 m near Yea to the north; the average height of the surface is 600 m. The increase in elevation to 800 m is due to the resistant Mount Disappointment Granodiorite. Its southern boundary is an erosion scarp striking WNW.–ESE. from near Heathcote Junction, extending just south of Kinglake to Toolangi (Fig. 1). Hills (1959) suggested that peneplanation of the surface would have been completed by Late Triassic times.

Two eroded residuals of the Triassic Erosion Surface, the Dandenong Ranges and the upper part of the Warramate Hills, occur to the south within the Nillumbik Terrain. The western boundary only of the erosion surface of the Dandenong Ranges may have been reactivated by faulting during the Late Tertiary (Jutson 1911). This implies a reversal of movement for the Montrose Monocline from east during Palaeozoic to west in Late Tertiary. Vandenberg (1971) however, stated that the present height above sea level is due to the resistance to erosion of the rhyodacites of the Mount Dandenong Volcanics Group, in particular the Ferny Creek Rhyodacite. Both models can satisfactorily explain the present configuration of the Dandenong Range.

The erosion surface of the Warramate Hills is probably a southerly extension of the Triassic Erosion Surface and occurs at an elevation of about 310 m. The soils above this level are thin; below this altitude they are thicker (up to 1 m at approx. 495485) and red like those of the Erosion Surface further north. Recognition of a residual of the Triassic Erosion Surface at this elevation demonstrates that it is warped and tilted to the south. Preservation of this surface has been aided by the resistant quartzites of the Dargile Formation, which also explains the absence of thick soil horizons above 310 m.

The Nillumbik surface was described as a peneplain by Jutson (1911) but Hills (1934) regarded it as a terrain. It had been encroaching upon the still older Triassic surface, when it was subjected to uplift and tilting and a new cycle of erosion and dissection was initiated upon it. It extends east to Healesville where it meets an extension of the Triassic Erosion Surface. Downfaulting of part of the Nillumbik Terrain on the pre-existing faults produced the Croydon Sunkland.

The Croydon Sunkland ranges in elevation from 40 m to 90 m except for two areas where the height is 155 m; these are at the 'Chirnside Estate', immediately west of Lilydale, and at 'Yerinberg', east of Coldstream. The height of the 'Chirnside' area is due to a resistant capping of Early Tertiary volcanics and sediments whilst the Yeringberg Hill owes its existence to the hardness

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of its constituent quartzites. The decrease in height of the Sunkland, the Nillumbik Terrain and the Kinglake Plateau southwards indicates regional tilting to the south. The Dandenong Creek and tributaries of the Yarra such as Steeles Creek, Woori Yallock Creek, Dixons Creek, Olinda Creek, Brushy Creek and Badgers Creek, have modified the topography of the Sunkland, but to a minor degree.

STRUCTURE

Recent work has shown that the major structural controls on the physiography of the area are faults; viz. the Yarra, Tarrawarra and Yeringberg Faults (Figs. 1 and 2) supporting the faulting hypothesis originally proposed by Jutson (1911).

(a) *Yarra Fault*

Originally defined by Jutson (1911) on purely physiographic grounds, its existence was rejected by later workers (Hills 1934; Gill 1940, 1942, 1949, 1965; Moore 1965). The following structural and stratigraphic evidence needs consideration in deciding whether it is a fault or not:

(i) The strike of the beds of the Dargile Formation (Thomas 1939) partly comprising the scarp (Fig. 2) differs by up to 30° from the trend of the scarp; this is especially so between Yan Yean co-ords 380570 and 300470. If the scarp were the result of erosion one might expect it to follow the strike of the hard Dargile quartzites.

(ii) An important anticlinal axis has been disrupted by the fault (Fig. 2) south-west of Yarra Glen.

(iii) Only 920 m of strata of the Dargile Formation outcrops on or adjacent to the scarp on the Yarra Glen-Christmas Hills Road compared with 1700 m in a conformable sequence in the Croydon area to the south, indicating that 800 m or so of section have been lost by faulting in the Yarra Glen area giving a minimum throw of 1300 m to the east. The presence of quartz porphyry dykes along the fault scarp north of Wonga Park and at Steeles Creek may be associated with a fault.

(iv) Displacement of strata patterns and development of local shear zones with overturned and crumpled strata were seen at Wonga Park and Yarra Glen, also suggesting the presence of a fault.

(b) *The Tarrawarra Fault and Ring Dyke*

This is a major EW. fault forming the northern part of the Tarrawarra Ring Dyke. Evidence of the existence of the fault is provided by the lateral displacement of both strata and fold axes (Fig. 2) in the vicinity of the River Yarra 1·6 km west of Healesville. The fold axes become unrecognizable near the Tarrawarra Fault; contortions of the strata and limited outcrop prevent tracing of folds across the fault zone. The increased development of younger beds south of the fault, near Yarra Glen and Healesville demonstrates downthrow to the south. Its position can be located by arcuate quartz porphyry dykes north and south of the River Yarra.

(c) *Yeringberg Fault*:

Units within the Siluro-Devonian sequence of the Melbourne Trough are typically persistent. Sudden absence of this prominent sandstone member of the Humevale Formation 04435500 indicates a fault as shown (Fig. 2) with a downthrow to the east.

CONTROL OF PHYSIOGRAPHY

The Yarra, Yeringberg and Tarrawarra Faults are thought to have originated during the Palaeozoic. The Tarrawarra and Yarra Faults are associated with quartz porphyry intrusions thought to be contemporaneous with the Late Devonian Cerberean and Mount Dandenong Igneous Complexes. The Yeringberg Fault, however, pre-dates the Mount Dandenong Igneous Complex because the Coldstream Rhyolites are unaffected by the fault (Fig. 2).

Late Tertiary to Early Quaternary movements (Neilson 1967, 1970) along pre-existing lines of weakness produced the Yarra scarp, caused rejuvenation of the Dandenong Ranges and thus gave rise to the Croydon Sunkland; Vandenberg (1971) has also suggested that they reactivated the Beaumaris Monocline and produced the Wheelers Hill Fault.

The Late Tertiary to Early Quaternary faulting caused widespread aggradation of the Yarra and Dandenong Creek Valleys (Fig. 1) upstream from the Wonga Park area, creating the extensive Yarra Flats of the Yarra Glen-Healesville district. Late Tertiary vertical movement along the Yarra Fault is of the order of 60 m. Patches of river alluvium have been found along the scarp between Wonga Park and Yarra Glen at least 30 m above the river's present level. The antecedent drainage pattern indicates that the displacement was slow or intermittent (Jutson 1911). This uplift caused the development of Yering Gorge, between Wonga Park and Yarra Glen, and the gorge between Warrandyte and Wonga Park.

The origin of the Brushy Creek Scarp is still undecided. Kenley (pers. comm. 1969) observed a broad zone of slickensiding and shattering at Croydon, north-east of the Maroondah Highway. Jutson (1911) proposed on physiographic grounds that the scarp was fault controlled, but Hills

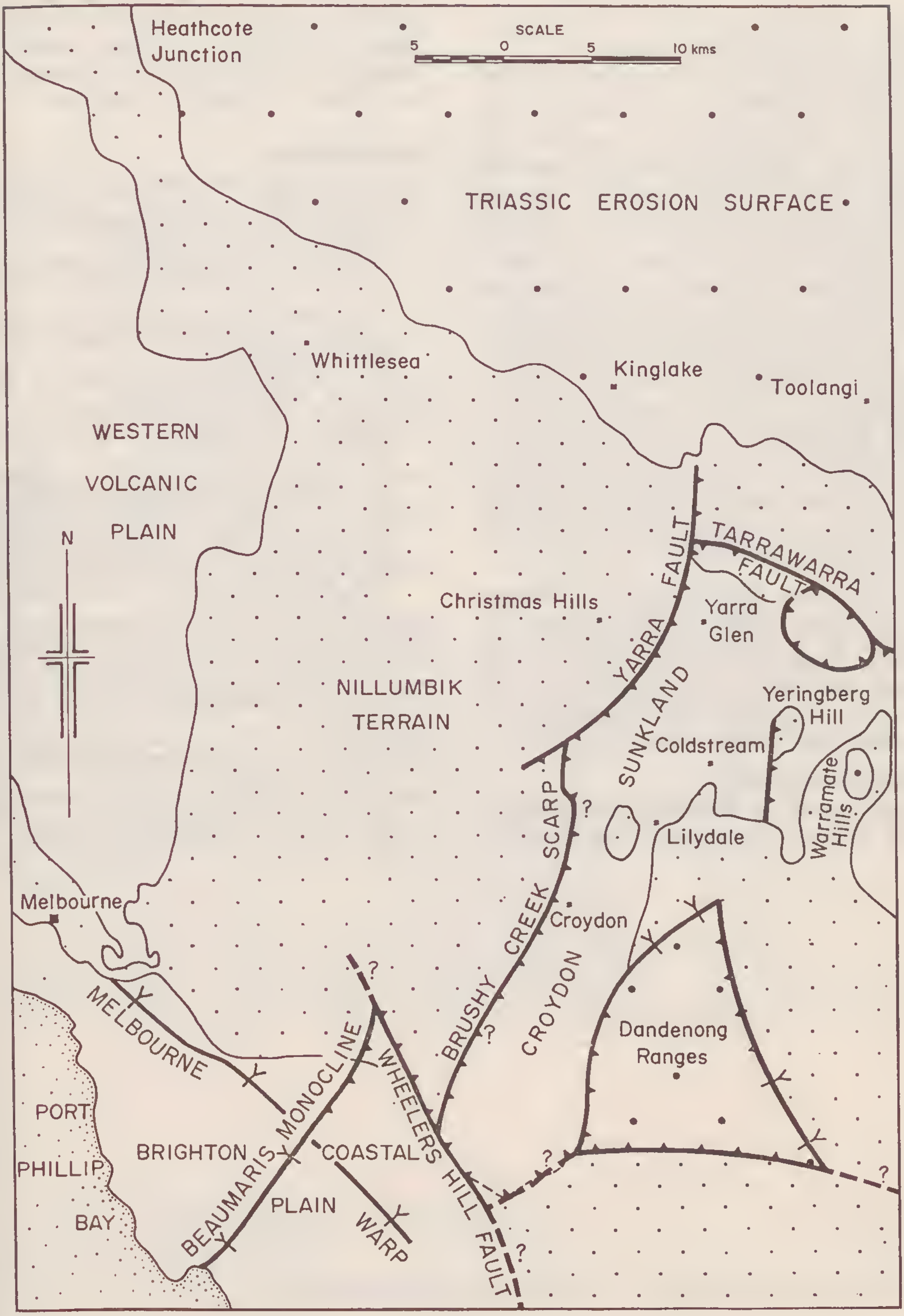

FIG. 1—Physiographic divisions of Central Victoria modified from Neilson (1967).

(1934), Gill (1940, 1942, 1949, 1965), Moore (1965) and Vandenberg (1971) have maintained that it is an erosion feature only.

Vandenberg (1971) proposed that the Late Tertiary-Early Quaternary movements of the area resulted in the formation of the Wheelers Hill Fault scarp and the Beaumaris Monocline. It is probable that both faults represent reactivated Palaeozoic faults, because both the fault and monocline are in a direct line through the Brushy Creek scarp with the Yarra Fault scarp further north. It would be a remarkable coincidence if the Brushy Creek scarp were not fault controlled like these southerly extensions. Recognition of the Brushy Creek scarp as a fault scarp naturally has been equivocal, because if a fault, it would be a strike fault. All three faults mentioned above are downthrown to the east. The thickness of the Dargile Formation just south of Wonga Park is still less than the 1700 m encountered at Croydon, suggesting some loss of strata in the northern part of the scarp. The Yarra Fault intersects the Brushy Creek scarp at 60° and completely cuts out the Dargile Formation between Wonga Park and the River Yarra.

The Tarrawarra Fault, although of Palaeozoic age, has indirectly influenced the topography by restricting the outcrop of the resistant Dargile Formation south of the fault. The intersection of the ring dyke and the River Yarra both on the Yarra Glen and Healesville sides of the fault have caused the Yarra to change course (Fig. 2).

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